tons per kilowatt year, and two tons of carbide will absorb practically 500 kilograms of nitrogen in the form of nitrolim. A power of about $2\frac{2}{3}$ h.p. is required per year for fixing each ton of nitrogen, and in addition to this about one-third horse-power is required for the grinding and all other mechanical operations. Consequently, to produce sufficient nitrolim to take the place of all the Chili saltpetre at present consumed annually, plant developing no less than 800,000 h.p. would be required. Not only is nitrolim useful as a fertiliser, but quite a large variety of chemical products have been made by means of it. For instance, by melting it with a flux, a mixture containing 25 per cent. of potassium cyanide, which is found to work quite as efficiently for the extraction of gold and silver as the pure product, is produced. It comes on the market under the name of "Surrogate." Ammonia may be produced very readily from this product, and may be collected pure or used for making salts of ammonia. (Fig. 3 shows diagrammatically the form of plant employed.) Another product is dicyandiamide, which is being used in increasing quantities for the manufacture of organic dyes. Besides which there are urea, thiourea, ferricyanide, and a variety of other products.

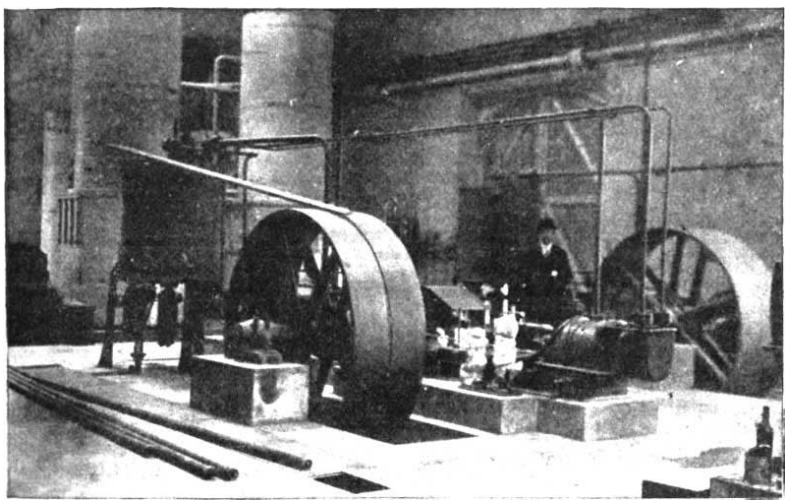

FIG. 6.—Linde Machinery.

As a commentary upon the Birkeland-Eyde process worked at Notodden, it is of interest to notice that the Cyanamide Company at Odda fix about the same quantity of nitrogen as the Birkeland-Eyde; but whereas the former employed about 25,000 kilowatts of power, the energy required by the latter company is between five and six thousand kilowatts. It would thus appear that the actual fixation is cheaper in the form of cyanamide than in that of calcium nitrate. At the end of the present year it is hoped that works having a total output of 45,000 tons of nitrogen will be in operation, and in the course of next year a correspondingly large increase in production of this product is predicted. It should be mentioned that the first plant upon an industrial scale was started about two and a half years ago, at Piano d'Orta, in Central Italy, with a yearly production of about 4000 tons of nitrolim. These works are now being increased to a capacity of 10,000 tons. Other important works are being started in Italy; the power employed is hydro-electric.

Works are being erected in Austria-Hungary, and at the present time a water-power installation, giving at least 50,000 h.p., is being erected at Almissa. In France the Société Française des Produits Azotés has installed works at Nôtre Dame de Briançon (Haute Savoie) having an output of 4000 tons, and these have been in operation for about six months. In Germany, at Westeregeln and Brühl, on the Rhine, 10,000 tons of nitrolim are being annually manufactured. It should be noticed, however, that the works at Brühl do not employ water power, but as the coal in this district is cheap, it is used in place of water power. In the United States the American Cyanamide Company are constructing works on the Canadian side of the Niagara Falls, with a capacity of from five to six thousand tons per annum, which it is hoped to enlarge later on so as to produce 40,000 tons.

The chief British enterprise is the North-Western Cyanamide Company, Ltd., which has erected works at Odda. Figs. 4 and 5 show the Isere Valley, Nôtre Dame de Briançon, and the main buildings of the cyanamide works. Fig. 6 shows the Linde machinery employed there for fractional distillation of the air.

F. M. P.

THE EDUCATION OF THE BLIND.[1]

THE jubilee year of the Institution for the Blind at Illzach-Mülhausen has been celebrated by the publication of a "Festschrift," which contains addresses and papers by Prof. Kunz and others at the congresses regarding the blind held in Frankfort in 1882, Amsterdam, 1885, Kiel, 1891, Berlin, 1898, Paris, 1900, Breslau, 1901, Halle, 1904, Leipzig, 1905, and in Rome, 1906. There is first an interesting account of the development of the Institution at Illzach since its foundation in 1856. Institutions for the blind were founded in various cities long before this date. Thus, to select from a long list of the chief cities of the world, we find one in Paris in 1784, in Liverpool (the first English institution), 1791, Edinburgh, 1793, London, 1799, Berlin, 1806, St. Petersburg, 1807, Stockholm, 1808, Dublin, 1810, Barcelona, 1820, Munich, 1826, New York, 1831, Bern, 1836, Padua, 1838, and Madrid, 1842.

The home at Illzach was at first small and modest, but it grew rapidly, and now it is one of the best equipped blind asylums. From the first its founders had in view that it was not merely to be a home for the blind, but a school in which all the elements of an ordinary education, and also of a technical education, could be taught. Nothing is more ingenious than the methods now adopted for the education of the blind, more especially by the sense of touch. Reading by raised type, or by a system of raised points so grouped as to represent numerals or letters, arithmetic, grammar, geometry, geography by raised maps, natural history by specimens of plants and animals or by anatomical models, or the outlines of plant and animal forms in bas-relief, music—theoretical, vocal, and instrumental—and gymnastics, and many technical arts are also taught, such as sewing,

1 Geschichte der Blindenanstalt zu Illzach-Mülhausen i E. Während der ersten fünfzig Jahre ihrer Tätigkeit, ferner deutsche, französische, und italienische Kongressvorträge und Abhandlungen über das Blindenwesen, Prof. M. Kunz, Direktor der Anstalt, 1856–1906. Pp. 346. Leipzig: Wilhelm Engelmann, 1907.)

knitting, basket-making, mat-making and brush-making. Special maps and even pictures are now made for the blind. There are numerous illustrations of these in the volume. The blind children are taught to take part in plays, some of which are complicated enough to tax the powers of those having vision, and, of course, in music of all kinds, many of the blind attain to remarkable proficiency.

The second part of the work deals with the various congresses. These were largely attended, and papers were read which opened discussions on the best methods of teaching the blind. Each congress had its own speciality. Thus at Kiel, 1891, the subject was the modelling of animal forms; and at Berlin, 1898, it was the teaching of music and grammar. Even comparative grammar was taught to advanced pupils, and those interested in the relationships of languages will find much that is suggestive in the record of the Berlin conference (pp. 130–145). At the Paris conference in 1900, the important question was discussed whether blind children should be taught by blind teachers, and, if so, to what extent? There appear to have been considerable differences of opinion upon this point. The French, Belgians, and Italians made great use of blind teachers, but in Germany and other northern countries the greater part of the teaching was done by those who see, and the blind teachers were only helpers. Prof. Kunz has an important article on this question, and he has arrived substantially at the conclusion that the proportion of seeing to blind teachers should be about two to one. Many blind teachers have, however, attained wonderful skill in imparting knowledge to their unfortunate brethren, and a feeling of sympathy and subtle intuitions, related to personal experience, may to some extent account for their success.

One of the most interesting chapters in the volume is that entitled Zur Blindenphysiologie, das sogenannte "Sinnenvikariat" (p. 186). It might be called the "psycho-physik" of the blind. The results of various experimental inquiries are given, and it is shown that in the blind, taking the average of a large number above puberty, all the other senses are capable of more delicate perceptions than in those who can see. As might be expected, the sense of touch is highly developed. This is of great importance, as it enables the blind to use with accuracy the Braille method of designating letters by various patterns of points, which are sometimes sharp and of varying size, sometimes wedge-shaped, and sometimes the marks consist of thin vertical and horizontal lines, either single or meeting at various angles. An address by Prof. Kuntz at Halle, in 1904, gives much information as to the spread over the world of the methods of teaching the blind. This is followed by an interesting description, with numerous illustrations, of the many forms of type suitable for reading, for arithmetic, and for music, and nothing could show more clearly the delicacy of the sense of touch acquired by the blind during their education than an inspection of these curious patterns. Dr. Javal, the eminent Parisian ophthalmologist, contributes an interesting chapter on some physiological features of the blind.

There is an elaborate paper bearing on the perception of the direction of sound by the blind, and the acuteness with which they perceive the nearness and often the nature of objects by reflection of sound-waves. The whole subject has been investigated with the greatest care. It is interesting to find a translation into modern Greek by Fräulein Irene Lascaridi (a teacher in the Asylum for the Blind in Athens) of Prof. Kunz's paper on the physiology of the blind, Περὶ τῆς Φυσιολογίας τῶν Τυφλῶν. Several examples of raised type and maps are shown at the end of the volume. The book is not only worthy as a "Festschrift," as it contains all that can at present be written upon the subject of the education of the blind, but it will be an enduring monument to the zeal, devotion, and learning of Prof. M. Kunz, who has devoted his life to the interests of those who are deprived of one of the most important of the senses.

JOHN G. MCKENDRICK.

CATALOGUE OF DOUBLE STARS.[1]

PROF. G. W. HOUGH, director of the Dearborn Observatory, while observing with the 18½-inch refractor, discovered 648 double stars. These stars consist of close pairs and of pairs where the companion is very faint; they are, therefore, difficult to measure, and may be regarded as of the same class as those discovered by Prof. Burnham. But whereas the Burnham stars have been fairly well observed and yield a good percentage of binaries, the Hough stars have been very little observed, and they yield few interesting pairs.

Prof. Doolittle, of the Flower Observatory, has done good work in collecting these 648 stars in one catalogue, and arranging this catalogue in a form which leaves nothing to be desired. The stars are not entered according to the Hough number, but in order of right ascension, and the meridian catalogue name is added; but to facilitate reference, a list of the stars is given in order of the Hough number, with the page in the catalogue on which the star appears.

In addition to his own measures, made at the Flower Observatory of the University of Pennsylvania, Prof. Doolittle gives measures by other observers, which unfortunately are few. From the Astronomer Royal's report and from the Greenwich results published in the Monthly Notices of the R.A.S., we gather that the Greenwich observers have been at work on the Hough stars, and it seems a pity that more of these measures could not be included. It may be that Prof. Doolittle experienced difficulties in publication which retarded the appearance of his catalogue. This would make it seem of later date than it really is, and would also explain the phrase in the introduction—"Mr. Burnham's new general catalogue, when it is published," &c. The general catalogue has been with us since August last.

The right ascensions and declinations are given for 1880. This, in a catalogue of 1908, means that the right ascensions are practically 1½ m. wrong to start with, and the declinations sometimes 8′ or 9′ out, thus necessitating the application of precession corrections by everyone using the work, whereas if the places had been given for 1910 they would have been useful for many years.

Prof. Doolittle began systematic work in 1901, and the catalogue he has produced is an important piece of work well carried out, and the printing is very good, the few errors being easily rectified. But owing somewhat to the uninteresting character of the Hough stars, he has had little beyond the actual catalogue itself to repay him for his labour. With the exception of Hough 212, and possibly two others, there is no object in the whole catalogue of any remarkable interest at present; and the paragraph on p. 10 of Prof. Doolittle's introduction must evidently be read in the light of the well-known characteristics of the Hough stars. In this paragraph he gives thirty pairs as being *clearly binary systems in rather rapid motion.*

Astonishment at the large number was increased on an analysis of the thirty. From the notes in the

[1] "Catalogue and Re-measurement of the 648 Double Stars discovered by Prof. G. W. Hough." Publications of the University of Pennsylvania, Astronomical Series, vol. iii., part iii. Pp. 176. (Pennsylvania, 1907.)